

QUARTERLY PERISCOPE.

FOREIGN INTELLIGENCE.

ANATOMY.

1. *Professor Ehrenberg's discoveries relative to the Structure and Functions of the Infusoria.*—If the obscurity which involves many of the most interesting phenomena in human physiology be ever dispelled, it can only be by the lights furnished by comparative anatomy, and we therefore conceive that we cannot occupy a few pages better than in devoting them to an account of the discoveries of Professor Ehrenberg, of Berlin, relative to the structure and functions of the Infusoria. These discoveries constitute an epoch in that department of science, both from the capital discoveries already made as well as from the direction they give to future researches. The best account we have seen of these discoveries, is that by Dr. GAMMSEN, in the *Edinburgh New Philosophical Journal*, for Sept. 1851, and we shall make free use of it in making up the following sketch of the structure and functions of the Infusoria.

Our readers will perhaps be surprised at the mention of the structure and functions of animals, the discovery of whose mere existence has been until recently deemed the ultimum of zoological research, and regarding whom, the sum total of our knowledge has been hitherto confined to a few details on their external forms and active motions. Yet, in the midst of their transparent tissues, the German naturalist has, by a peculiarly ingenious method of observation, developed a highly complicated organization, which, with those who arrange the animal kingdom in a linear series, will remove them far from the extremity of the scale. The existence of a digestive, muscular, and generative apparatus, is established beyond doubt; and organs have been also discovered, which bear great analogy with the vascular and nervous systems.

Before entering into the detail of the organization of the Infusoria, it is proper to state briefly the method by which the organs are rendered visible. This consists in furnishing the infusoria with organic colouring matter for nutriment. Simple as this may appear, it was not until after ten years' observations, that Dr. Ehrenberg succeeded in selecting the fittest substances, and in applying them in the manner best adapted for the satisfactory exhibition of the phenomena. It was not until he used pure indigo, that these experiments succeeded in a desirable manner. Immediately on a minute particle of a highly attenuated solution of this substance being applied to a drop of water containing some of the pedunculated vorticella, (which are best adapted for the first observation,) and placed under the object glass of the microscope, the most beautiful phenomena present themselves to the eye. Currents are excited in all directions by the rapid motions of the cilia, which form the crown round the anterior part of the animalcule's body, and indicated by the movements of the particles of indigo in a state of very minute division in different directions, and generally all converging towards the orifice or mouth of the animal, situated, not in the

centre of the crown of cilix, but between the two rows of these organs which exist concentric to one another. The attention is no sooner excited by this most singular and beautiful phenomenon, when presently the body of the animal, which had been quite transparent, and bearing much resemblance in aspect to some of the marine Rhizostomæ, becomes dotted with a number of distinctly circumscribed circular spots, of a dark blue colour, exactly corresponding to that of the moving particles of indigo. In some species, particularly those which are provided with an annular contraction or neck, (such as the *Rafifer vulgaris*,) separating the head from the body, the indigo particles can be traced in a continuous line in their progress from the mouth to these internal cavities.

It is requisite in these experiments to employ colouring matter which does not chemically combine with water, but is only diffused in a state of very minute division. Indigo, carmine, and sap green, are three substances which answer very well the necessary conditions, and are easily recognised by the microscope. But whatever substance is used, we must be very particular that it contains no lead, an impurity which very frequently enters into the colours of commerce.

The microscope which Dr. Ehrenberg has used in all his investigations is one constructed by Chevalier of Paris; it possesses a power of 800. In very few cases, however, is it necessary to use this high power, and only to demonstrate the existence of an internal cavity in those species which do not exceed from 1-1500th to 1-2000th of a line in diameter, such as the *Monas termo*, *alonus*, and *lens*, and which almost elude the power even of so powerful an instrument. In almost all cases, a power of from 500 to 400 is sufficient; and Dr. Ehrenberg has made all his observations and drawings of the structure of the *Hydatina senta* with a power of 380.

In conformity with the great axiom of scientific observation, to measure every thing which is capable of measurement, Dr. Ehrenberg has not neglected to express in numbers the dimensions not only of the totality, but also of the important parts of these beings, placed as it were at the verge of organized nature. For this purpose he uses a glass micrometer, constructed by Dollond, which gives directly the ten-thousandth part of an inch, and permits of a much smaller quantity being correctly estimated, as it contains the astonishing number of 400 equal parts distinctly cut in glass within the space of half a line. By means of a micrometer screw, which has been since constructed by Pistor of Berlin, he has been enabled to measure directly 1-48000th of an inch, or 1-4000th of a line, a degree of minuteness which is never necessary in actual practice.

1. *Digestive System.*—By the use of colouring matter in the way above-mentioned, a digestive system has been demonstrated in *all* the genera of this class of animals, distinctly characterized by Müller. This fact Dr. Ehrenberg states in the following proposition: "All true infusoria, even the smallest monads, are not a homogeneous jelly, but organized animal bodies, distinctly provided with at least a mouth and internal nutritive apparatus." In none has the cuticular absorption of nutritive matter ever been observed, which had been the opinion of all previous writers upon the subject, not from any positive observations, but merely from their inability otherwise to explain the nutrition of these animals. Generations of these transparent gelatinous bodies may remain immersed for weeks in an indigo solution, without presenting any coloured points in their tissue, except the circumscribed cavities above referred to; and when in a state of activity, the minute particles of indigo and carmine are seen to hurry rapidly over the whole surface of their transparent bodies, in order to reach the mouth, generally situate at one or other of their extremities. Indeed there is no necessity of having recourse to such a supposition, when we can clearly see the prehension of colouring particles, their reception into a mouth, and conveyance from thence into an internal stomach or stomachs.

The alimentary canal presents, as in the other classes of the animal kingdom, the utmost variety in respect to form, situation and degree of complication. It is in the *Monas termo*, *pulvisculus*, and other larger monads, simply a round sac in the centre, and occupying the greater part of their bodies. In the genera

Enchelys, *Paramacium*, and *Kolpoda*, it assumes the form of a long intestinal canal, traversing the greater part of the body, and at times convoluted in a spiral manner, which is furnished with a great number of cæcal appendages, or stomachs; this singular disposition, of which no other example occurs in the animal kingdom, is particularly distinct in the *Leucophrys patula*. That these blind sacs are real stomachs, and do not at all correspond to the cæca of other animals, is evident from the fact of their being filled with colouring matter immediately on its being received at the mouth, or anterior orifice of the canal. The tubes which connect these sacs to the main canal of the intestine, vary very much, both in length and in diameter, as well among the different cæca, as in the same one at different times, being usually in a state of great contraction, and at times scarcely perceptible when the cavity to which it belongs is empty, and may be supposed not to be in a state of activity. We can count from 100 to 200 of these sacs in the course of the intestine of the *Paramacium chrysalis* and *aurelia*. When they are filled with colouring matter, the common intestinal tube is usually quite empty and transparent; this, joined to the bluish, reddish, or greenish tint which they often assume when empty, may have been the reason that these sacs were mistaken by Müller for ova, and by Schweigger for internal menads still adhering to the parent trunk. In other infusoria, as the *Rotifer vulgaris*, the alimentary canal is in the form of a slender tube, and extending nearly the whole length of the body, and terminating at its anal extremity in a dilatation or cloaca for the reception of the ova and the male seminal fluid, previous to its termination at the surface of the animal. Others of larger dimensions, as the *Eosphora najas* and *Hydatina senta*, and in general all the natural group of the *Rotatoria*, possess a single cavity of considerable size and oval form, situate in the anterior part of the body; the *Zygotrochis nudis* would seem to form an exception to the general rule of this division; for this animal, when filled with colouring matter, presents a slender, spirally convoluted intestine in the centre of the body. In this animal also, the posterior cloacal dilatation is enlarged into a considerable cavity, which can retain the colouring matter for some time previous to its being discharged by the anus.

The number of stomachs varies no less than their form. The whole tribe of the *Rotatoria*, as already observed, possess but a single cavity. In the *Monas termo*, four can be reckoned.

The number of sacs, which are so many distinct digestive cavities, although connected together by a common tube, varies from 1 and 200 down to 36 in many *Vorticellæ*. The largest number is in the *Paramacium chrysalis*, Müll., where it amounts to 120, and yet there is ample space for still more.

The anus is easily distinguished from the mouth, when the animal is filled with colouring matter, by its discharge from this orifice, in large irregular coherent masses, very different in appearance from the minute state of division in which it enters by the mouth. Its position varies exceedingly; in the greater number, such as the *Hydatina senta*, *Rotifer vulgaris*, and *Eosphora najas*, it opens towards the posterior extremity of the animal; in the first of these it is on the back. In the *Kolpoda cucullus* it opens into the concave surface of the animal, close to the mouth, from which it is only separated by a tongue-shaped eminence. In some of the spirally pedunculated vorticellæ, its disposition is very singular, opening along with the mouth into a common fissure, which is not situate in the centre of the circular ranges of ciliæ which surround the anterior extremity of the body, but towards the margin, between two of these concentric circles.

The mouth merits the notice of the systematologist, from the very precise characters which he can draw from thence for his subordinate divisions. This organ reaches its greatest complication in the *Hydatina senta*, where it consists of an orifice opening in the centre of a globular head, and provided with a pair of serrated mandibles, each resembling somewhat the single mandibles of some of the mollusca, such as the common *Helix pomatia*, or those of the echini.

When the animal is in the act of taking its food, these mandibles are in perpetual motion, opening and shutting with great rapidity, to absorb the colouring particles brought within their reach by the currents excited by the motions of the cilix. This very singular organization is certainly one of the most curious phenomena visible in their whole structure, and is perhaps one of the most important, as showing so close an approximation to animals far removed from them in the zoological series. Each mandible in the species which I examined, possessed five distinct teeth, but the number varies from two, three, as far as six. Dr. Ehrenberg has since succeeded in demonstrating their real nature, by the use of very fine folix of mica, (the whole animal is not more than one-eighth of a line in length,) and has come to the conclusion that they are separate, simple, hard bodies, enveloped with a fleshy covering, which are ingrafted into one another like the fingers of the hands when joined.

The mouth of the other infusoria is a simple unarmed opening, surrounded more or less closely with a greater or less number of cilix. Its position generally determines their anterior extremity. In the genus *Paramacium*, however, it is in the middle of the length of the animal. The *Kolpoda cucullus* possesses a sort of lip surrounding its margin.

The cilix play a very important part in the economy of this class of animals. They may be considered as the principal organs of taste, of touch, and of propulsion. When the animal is at rest, they are often quite imperceptible, but on the addition of a small proportion of colouring liquid to the drop of water, they become very apparent, being in a state of great activity, seeming to be the principal agents by which they excite those currents which afford so beautiful a spectacle under the field of the microscope.* In the *Monas pulvisculus*, and other larger monads, their number amount to 10 or 20, and we may from this conclude that they exist even in the smallest monad. They sometimes surround the mouth in a single row, (*Vorticella convallaria*, *Rotifer vulgaris*,) sometimes in a double row, (*Vorticella citrina*;) occasionally they extend in regular lines, or are irregularly dispersed over the whole surface of the body. The former disposition occurs in the *Leucophrys pyriformis* and *patula*, the latter in the *Aelinophrys sol*. They occupy, in other cases, only one side of the body, (*Kolpoda cucullus*.)

An *oesophagus* can only properly be said to belong to those which, like the *Eosiphora najas* and *Hydafina senta*, possess a notable contraction between the mouth and the stomach. This is especially distinct in the latter, where I have distinctly traced the passage of individual coloured globules along this narrow canal from the mouth into the intestine.

Perhaps this is the most appropriate place to notice an organ of a very obscure nature, which Dr. Ehrenberg dignifies with the name of a pancreas. It is in the form of two kidney-shaped, grayish-white, glandular-looking, transparent bodies, which are placed on each side of the upper extremity of the intestine, firmly connected to, and closely embracing it. Dr. Ehrenberg regards them as bearing a greater analogy to the pancreas than to the liver of the higher animals, from their colour, form and connexions. They must, however, be left to further inquiries.

2. *Muscular System*.—A fibrous muscular tissue being the proper agent of all voluntary contraction in the animal kingdom; we might, *a priori*, expect its existence in the class of infusoria, which are so remarkable for the rapidity and energy of their movements of propulsion and translation. In the former they can only be compared with fishes, and in the latter with insects. Contractility of tissue can never explain those active voluntary efforts by which they avoid obstacles when swimming in myriads in a single drop, convey the nutriment towards the mouth,

* One of the most favourable moments for seeing these cilix to advantage, particularly in those species in which they invest the whole surface of the body, is when the drop of fluid under the microscope is nearly dry, when they may be seen elongated to their utmost, in a state of great activity; or if the animal be nearly expiring, in a state of rigid erection.

and perform the act of deglutition. Previous, however, to Dr. Ehrenberg nothing like the muscular fibre had ever been attempted to be shown in these animals.

As yet, from their extreme tenuity, no distinct fibres have been detected in the second and more minute division styled by Cuvier Homogeneous Infusoria, and in the new system of Dr. Ehrenberg *Polygastrica*; although from their extremely vigorous contractions, as well as from their presence in the division of the Rotatoria, we are entitled to infer their existence. In this last, distinct fibres are perceptible in the *Eosphora najas*, *Rotifer vulgaris*, *Philodina crythrophthalma* and *Hydatina senta*.

We shall select the muscular system of the latter, the *Hydatina senta*, as a specimen, from its greater distinctness and complexity. The perfectly transparent gelatinous body of this animal, when seen through the microscope with a power of 380, appears to be traversed longitudinally by several narrow bands of fibres, perfectly transparent, and of a grayish-white colour. When the animal throws itself into its violent lateral contortions, these fibrous bands are observed to shorten, become broader and thicker, (from their slightly diminished transparency,) on the side towards which the contractions are made; and on the convex to become so extremely elongated and attenuated as to be almost, in some cases, quite imperceptible. The real muscular nature of these organs, and that they are the real agents in effecting the motions of the animal, is thus placed beyond all doubt. These muscles never lose their apparent state of tension, which they would undoubtedly do on the contractions of the animal, if their nature was of another description; and when the two extremities of the body are equally approximated to each other, none of the bands become invisible, but all increase to nearly twice their former breadth, with a corresponding diminution of their transparency.

The envelope of the body of the hydatina consists of a double transparent membrane, the two layers of which are in contact with, and scarcely distinguishable from, each other, when the animal is in a state of repose. But, upon the contractions of two or more of the muscles, the internal membrane into which they are inserted becomes separated to a greater or less distance from the external. During the whole of these phenomena the stomach, ovaries, and the whole of the viscera, are perfectly visible through the transparent muscles.

These principal muscles are four pairs, which take their origin from the opposite ends of the animal, and proceed in a radiated manner to be inserted by broad striated bands near the middle of the body, (between the fourth and fifth pair of twigs given off from what Dr. Ehrenberg calls the great dorsal vessel.) The four upper or anterior muscles rise by narrow insertions from the junction of the head with the body at the root of the rotatory organs; the four posterior or inferior, from the point of insertion of the bifid tail into the body. The extent of insertion of these muscles is much greater in the *Eosphora*, *Philodina* and *Rotifer*, than in the *Hydatina*; in them it reaches at least from the second to the sixth of the above-mentioned transverse twigs.

These great longitudinal muscles are distinct to the most unpractised eye, but Dr. Ehrenberg views as of a muscular character, 1. The seventeen sections of the rotatory organ in the *Hydatina*, which must be the principal agents in directing the motions of the cilia; 2. A contraction or sphincter near the extremity of the cloaca; 3. A striated organ behind the cloaca, which he considers, from its situation, as an accelerator of the seminal fluid, a *musculus ejaculatorius*. In none of these, however, except the last, can the existence of a fibrous tissue be considered as beyond a doubt; though, from their situation, it is more than probable that this is their true nature. All of these parts seem to be attached to the inner layer of the external double membrane, and to be unconnected with the subjacent viscera. It is not improbable that the tail may possess some proper muscles, as its motions are not performed laterally in common with the trunk, but by an alternate retraction and elongation.

3. *Generative System.*—The partizans of the *generatio spontanea vel primitiva*,
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who so long stood their ground in the class of Entozoa, after being forced to relinquish this position, by the discovery of the ova of these parasitic animals, took refuge in the darkness and obscurity of the microscopic infusoria, where they were almost secure of an undisturbed possession, while there was nothing known concerning them except as a homogeneous mass of transparent jelly, endowed with a few active motions; and where their negative arguments could only be attacked by analogical reasonings.

The candid and impartial mind of Müller himself, too rigid an observer to be seduced by the allurements of theory, considered the infusory animals as furnishing an incontrovertible argument for the existence of certain living forms, which are neither of oviparous nor gemmiparous origin, but derive their existence immediately from a certain indestructible living generative energy inherent to all matter;—for this very plain reason, that he had never witnessed the secrets of their origin. Such a conclusion, though perhaps too hasty, is allowable in such an observer. When, however, we see other men of distinguished talents, such as Treviranus and Oken, take up the question, where, if it were possible, they ought to have ended, and assume at once the existence of a mysterious power inherent in organic matter of generating infusory and other molecular animalcules, which form by their aggregation all organic living forms, and into which the latter are, at the cessation of their proper vitality, again resolved; we cannot help referring them to the well-known maxim of Bacon, that “*Homo nature minister et interpres tantum facit et intelligit quantum de natura ordine re vel mente observaverit: nec amplius scit, aut potest.*”

The observations of Dr. Ehrenberg have not only given an additional extension to the great principle of Harvey, *omne vivum ex ovo*; but have, by a connected train of ocular demonstration, proved the existence in this class of the whole three species of generation, the viviparous, the oviparous, and the gemmiparous, and even of the simultaneous exercise of two of these in the same individual, at different epochs of its existence. Waiving at present the corroboration which this might give to the view of infusory animals forming a parallel series to their more apparent prototypes, let us proceed to state shortly a few examples of each of these varieties.

In the interior of the *Rotifer vulgaris* we often see young animals of a diminutive size, (that of the parent varying from $\frac{1}{4}$ th to $\frac{1}{5}$ th of a line,) perfectly formed, and near the period of exclusion, which already possess the two red points, (eyes,) near their anterior extremity, and a distinct mouth and head. They assume various postures in the interior of the parent trunk, being at times coiled up in a spiral form, or extended to their whole length. These same fatus, if we may so call them, Dr. Ehrenberg has seen excluded in a living state from the parent. All the individuals of the *Hydatina* are hermaphrodite, possessing the completely formed male and female organs. The female consists of an ovary, which, when in the unimpregnated state, is an oval perfectly transparent bilobed bladder-like body, closely embracing the lower part of the intestinal tube. When in an impregnated state, it increases very much in size, being augmented by the addition of two or more oval appendages, so that the whole mass fills the greater part of the posterior half of the body of the animal. When quite ready to burst it assumes a greenish-gray colour. These rounded bodies communicate by a canal, scarcely perceptible in the unimpregnated state, broad and distinct when nearly ripe, with the cloacal dilatation formerly noticed as existing near the anal orifice of the intestine. That the ova are not internal germs, an opinion entertained by many older observers, such as Lamarck and others, is proved not only from the above-mentioned development and connexions of their containing vesicles, but also by the distinct existence of the three substances which in the ova of the Entozoa, M. Rudolphi considers as the chorion, allantois and amnion. In the centre of many ova there can be recognised a darker point, which is either the embryo, or cicatrix in which the latter is developed.

The adult *Hydatina* possesses, besides, two organs which Dr. Ehrenberg con-

siders as the male organs of generation, but the real nature of which is a little more doubtful than that of the preceding. They resemble very much in form the milt of fish, consisting of two elongated bodies, extending nearly the whole length of the animal, exterior to the ovaria, broader towards the head, diminishing towards the tail. They terminate, (a strong corroboration of this view of their true nature,) in a number of spirally convoluted tubes, which finally open by two separate canals immediately behind the oviduct. These spiral convolutions are enveloped by an organ of a very singular nature, the function of which is very obscure: it is oval, transparent, remarkable for its irritability and sudden changes of form; at one time swelling out into a vesicular form, at another contracting into a small glandular looking organ. Dr. Ehrenberg at one time considered it to bear some analogy to an uterus; but it is more probably connected with some office in applying the seminal fluid to the ova previous to the exclusion. This organ is wanting in the *Ilotifer* and *Philodina*, where the male apparatus otherwise resembles very closely that of the *Hydatina*.

In the *Kolpoda cucullus*, the parent animal excludes the ova in the form of extremely minute globules, bearing much similarity to some of the species of the genus *Monas*, connected by a number of filaments interwoven together in a reticular form. In an animal 1-24th of a line in diameter, that of the ova was 1-1000th of a line. The young *Kolpoda* were 1-14th of a line before they were distinctly seen to excite currents, and swallow the coloured particles. In the genus *Vorticella* there seems to be a combination of the oviparous and gemmiparous generations. The single species *Convallaria*, has, from their entire ignorance of its mode of development, been subdivided into no less than six distinct genera, by different observers, according to the variety in its form at different stages of its existence. It first appears in the form of minute points, not more than 1-1000th of a line in diameter, scattered upon the peduncles of a group of adult *Vorticellæ*. After a time these minute points enlarge in size, and send out delicate peduncular prolongations to the larger adult roots, in which state Schrank styled them *Vorticellæ monedicae*. When still more advanced these peduncles become coiled up in a spiral form. And when they may be considered as having reached their complete organic development, though still much inferior in size to what they afterwards attain, the usual currents may be observed in the coloured solutions in which they are immersed. The same species propagates itself by germs, on the separation of a part of its body from the parent trunk. This is performed in three different ways, each of which has been dignified with the title of a distinct form.

The first is the longitudinal division in which the animal divides itself into two nearly equal halves. A fissure first appears traversing the whole length of the body; this becomes deeper anteriorly, where two horns are now visible, each provided with a distinct set of cilia, and a mouth, recognisable by the two currents of colouring particles directed to the apices of the two horns. The fissure becomes deeper and deeper, till they form two distinct, perfectly formed animals, attached to the apex of a single peduncle; one of these is soon detached from the latter, when it agrees in form exactly with Lamarck's genus *Trecolaria*. When the same animal moves with the hinder part forward, it forms Schrank's genus *Ecelissa*; when the conical basis by which it was attached to the peduncle, has not quite disappeared, it forms Bory de St. Vincent's genus *Rinella*; and when a little broader and more bell-shaped, with apparently only two cilia, it is the genus *Kerubalanus* of the same author; when fully provided with cilia, without any remaining vestige of the conical appendage, it is the genus *Craterina*. This *Vorticella* also passes through the same phases of a *transverse* division into two equal independent animals. The third method is the true gemmiform division, as in the *Hydræ* and *Planariæ*, in which a small bud is given off from the posterior surface of the animal, which is provided with cilia, and when separated from the parent trunk, is still of a very diminutive size.

Such are a few of the observations on the generation of these animals, from which it will be seen that they are but in their commencement, and that much remains to the patience and labour of future observers.

4. *Vascular System*?—The existence of a digestive, a muscular, and a generative system of much complexity, and very far from what we might consider as their simplest expression, may now be viewed as an ascertained fact with regard to infusory animals. The existence of the two systems which remain for our attention, viz. the vascular and nervous, is as yet somewhat problematical. The organs on which Dr. Ehrenberg confers these appellations, are very apparent, but much doubt exists with regard to their real functions.

What has been denominated a vascular system is distinctly visible only in the *Hydatina senta*. Traces of a similar arrangement are now and then perceptible in the *Eusphora*, in particular positions of the animal, but they quite disappear when the integuments are in a state of strong tension. In the former, a series of transverse lines of a white colour, and inferior transparency to the rest of its body, succeed one another at regular intervals, from the head towards the tail. These transverse striæ might at first be taken for muscles, but they differ from these entirely in their aspect and connexions. They are nine in number, exactly parallel to, and nearly at equal distances from, each other. At first sight they seem to be complete rings encircling the whole body; but, upon a closer inspection, they are observed to diminish in breadth, and finally vanish on approaching the inferior or abdominal surface of the animal. On the contrary, they augment in diameter towards the back, where they all terminate at right angles, in a line, of an exactly similar appearance to themselves, running in a longitudinal direction from the head to the tail. This longitudinal line or vessel is nearly twice the caliber of any of its tributary transverse twigs.

It will be observed, that the disposition of this main dorsal trunk, with its collateral branches, is almost exactly that of the vascular system of the Ascidia, so beautifully demonstrated by M. Savigny, which is a strong argument for their being of the same character. No motion of an internal fluid is discernible in their interior, nor has any pulsation, analogous to a heart, been ever observed. Both these phenomena, which would decide the question as to their true nature, Corti asserted that he had observed in the *Rotatoria* and *Brachionus*, but he was deceived by the tremulous motion of the canal, leading from the mouth to the œsophagus. The same was the case with Grunthuyssen, who mistook the motion of the intestine in the *Paramacium aurelia* for that of a sap-like fluid. It is worthy of note, that these white striæ are attached to the internal, not to the external tunic of the integuments.

5. *Nervous System*?*—This name is given to a series of six or seven round glandular-looking grayish bodies, which envelope the upper or dorsal part of the œsophagus of the *Hydatina*. They are closely connected together, and are distinguished from all the other viscera of the body by their darker tint. The uppermost of these bodies, (ganglia,) or that situate in the mesial plane, is much larger than the rest, and gives off, from its apex, a slender branch which proceeds upwards towards the integuments at the back of the neck a little before the second pair of vascular twigs, where it forms a slight enlargement, (ganglion;) it does not stop here, but returns back and unites again, not with the large ganglion from which it was originally given off, but in one of the adjacent smaller ones. A complete circle is thus formed, bearing some resemblance to the nervous circle, which encircles the œsophagus of the mollusca, except that in this case the whole circle is situate on the dorsal or upper side of that canal. From the point of contact of this nervous circle with the dorsal vessel, it gives off two very slender twigs forward to the anterior part of the head, where, in other forms of the *Rotatoria*, such as the *Rotifer vulgaris*, the two red points, (eyes,) are situate. In some, such as the *Eusphora nejes*, a single large red point is situate on the back of the neck, in the exact position

* According to all our ideas of known physiological laws, the existence of active voluntary motion presupposes the necessity of an animating nervous system. Hitherto, however, no attempt had ever been made to prove its existence. But here again in these animals, excluded by their delicacy and minuteness from the ordinary means of anatomical investigation, the transparency of their tissues, as it has enabled us to discover the existence of a muscular, has now assisted us in the more than probable discovery of its necessary appendage, a nervous tissue.

of the ganglion at the apex of the circle.* The above-mentioned large mesial œsophageal ganglion, (brain,) sends off posteriorly another branch of much larger size, backwards along the abdominal surface of the animal, which closely adheres to the internal layer of its double envelope.

That these different filaments and ganglia, to which we have given the name of nerves, are not muscles, is evident from their form, their mode of insertion into the integuments, and because in the contractions of the animal they are not shortened, but assume a serpentine form, being apparently quite passive. They are not vessels, because no pulsation nor motion of a contained fluid has been hitherto perceived through their transparent tissues. If they are not organs of an entirely unknown nature, the whole analogy of their form and position, compared with that of the nervous system in other invertebrate animals, favours the idea of this being their true nature.

We may here consider as appendages to the nervous system, those coloured points situate in the anterior part of the head of these animals, and most usually on the dorsal surface, which have been considered as eyes. As already noticed, the first discovery of these organs was made in 1816 by Nitsch, who saw in the *Cercaria viridis*, (now referred by Dr. Ehrenberg to the genus *Euglena*,) three black scaleform points. In the *Rotifer vulgaris*, their pigment is of a red colour, and they are three in number, two small ones at its anterior extremity, and a single larger one at the nucha in the situation of the apex of the above-mentioned nervous circle in the *Hydatina*; and it is very probable that the two filaments, which in the latter animal are sent forwards from this ganglion, or even the ganglion itself, subserve the purposes of vision. The number, disposition, and colour of these points is the same in the *Eosphora najas*, where the mesial eye is still larger and more distinct. In the *Philodina erythrophthalma* their colour is the same, but they are only two in number, (the most common disposition in this class,) much smaller, and situate more posteriorly. In the *Lepadella ovalis* one only is visible of considerable size in the mesial situation of the large one of the *Eosphora*.

2. *Attenuation of organized matter.*—Some idea may be formed of the high degree of attenuation of which organized matter is susceptible from the following facts. By Professor EHRENBERG'S measurements, the *monas termo* does not exceed 1-1500 to 1-2000 of a line in diameter; and he states that the four stomachs did not occupy half the bulk of the animal. Each stomach must therefore be about 1-6000 of a line in diameter. Some of Professor Ehrenberg's observations tend to prove that the genus *monas* and some others are only the young state of some *kolpodæ*, *paramacixæ*, &c. But supposing them to be perfectly developed animals, and that their ova bear the same relation to the size of their bodies, which those of the *kolpodæ* do, that is, 40 to 1, we must conclude the existence of young monads which have a diameter of only 1-60000 of a line, or 1-720000 of an inch. Each of these monads must possess a stomach and organs passing in dimensions the power of numbers, and certainly giving us very magnificent ideas of the grandeur of organized nature.—*Ibid.*

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3. *Physiological Investigations arising from the Mechanical Effects of Atmospheric Pressure on the Animal Frame.*—The weight of the atmosphere, though not constantly the same, varying from 1-12th to 1-15th of its whole weight,† on

* The best view of the disposition and appearances of the œsophageal ganglia, is got from the dorsal side of the animal, in a line with the great dorsal vessel. The nervous collar given off from the brain, is however best seen on a lateral view.

† These variations are gradual, so that it requires some days or weeks before the weight passes from one extreme to the other.